Numerical simulations of turbulent flow and dispersion over urban and complex terrain by coupling WRF and LES models(abstract)

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Numerical Simulations of Turbulent Flow and Dispersion over Urban and Complex Terrain by Coupling WRF and LES Models

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Abstract

Understanding of turbulent flow and dispersion over urban and complex terrain is important for analyzing and predicting air quality and thermal conditions in those areas. For the numerical analysis on the turbulent flow and dispersion, both microscale turbulence and mesoscale/synoptic-scale processes should be represented in the simulations. This study investigated turbulent flow and dispersion in complex surfaces under real meteorological settings by conducting numerical simulations with both the Weather Research and Forecasting (WRF) model and a large-eddy simulation (LES) model. By developing an LES model for both flow and dispersion under various stability conditions, we used the simulated outputs by the WRF model as the inflow boundary condition for the LES model. In this coupling, perturbations were generated by a recycling technique, and those perturbation components were added to the WRF flows that were regarded as mean flows in an LES domain. The turbulence and dispersion measured in Oklahoma City during the field experiment Joint Urban 2003 were simulated by the WRF/LES modeling. Overall the simulated results well reproduced the boundary-layer flow and structure. The simulated dispersion fields agree well with the field measurements in some locations; however, in other cases the simulation disagrees with the measurements, because even a slight departure of the simulated winds to the measurements may result in a large discrepancy of the simulations from the observations. The analyses are extended to the flows over the urban area of Kyoto City and to the radioactive material dispersion from the Fukushima Dai-ichi Nuclear Power Plant.

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